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4TH INTERNATIONAL CONFERENCE ON BUSINESS AND ECONOMIC RESEARCH (4TH ICBER 2013) PROCEEDING
04 - 05 MARCH 2013. GOLDEN FLOWER HOTEL, BANDUNG, INDONESIA
ISBN: 978-967-5705-10-6. WEBSITE: www.internationalconference.com.my

TEAM DIVERSITY AND NEW PRODUCT DEVELOPMENT PERFORMANCE IN MANUFACTURING SECTOR: A CONCEPTUAL FRAMEWORK

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ABSTRACT

In achieving high new product development performance, new product development team was playing the important roles. People were important in performing a team to develop new product. Different background of team members was vital to ensure high new product development performance. Diversity of team members not only should be focusing on their functional diversity, also team members' experiences in new product development process should be considered. Team who did not have experienced people tends to achieve low new product development performance. Therefore, this paper presented a conceptual framework assuming that diversity of team members in terms of functional diversity and team members' experiences gave significant effects to new product development performance. This study also suggested that to investigate the relationships through empirical data of various industries in manufacturing sector in Malaysia.

Field of Research: New product development team, functional diversity, team experience, new product development performance.

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1. Introduction

Firms in developing countries such as Malaysia struggle in developing new product in order to compete in the global environment. New product development activities in Malaysian manufacturing firms are still lacking behind, which indicated only 10 percent conduct new product development compared to other European countries such as Sweden, Austria, and France that have the larger proportion about more than 40 percent in developing new product (MASTIC, 2002-2004). This circumstance occurred because they were not able to gain competitive advantage, overused financial resources, lack of capability to improve their low innovativeness and low quality control of the products.

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Currently, Dato' Sri Najib Tun Haji Abdul Razak, the Prime Minister of Malaysia has announced the allocation budget on innovation activities about RM 600 million in his 2013 budget speech. Besides, he also announced income tax exemption for ten years to company who commercializes new product development. This is because innovation is significant to this country in order to achieve high-income and developed nation by 2020 ("The 2013 budget speech," 2012).

Fourth National Innovation Survey (NSI-4) conducted by MASTIC (2002-2004) indicated that most of the firms in Malaysia carry out both product and process innovation activities, which comprise of 77 percent (299 firms) of the manufacturing companies were 41 firms carried out product innovation, and 24 firms carried out process innovation. Furthermore, most of the firms established in year 1990 to 1999, had an employment size between 50 to 249 employees and wholly local owned firms were involved in new product development activities. Longitudinal data of NSI-4 indicated that the number of new products introduced by innovating firms from 2001 until 2004 are increased fourteen percent compared to the new products introduced from 1999 until 2001.

2. New Product Development Concept

New product development is defined as "*the transformation of a market opportunity and a set of assumptions about product technology into a product available for sale"* (Krishnan & Ulrich, 2001). This definition emphasized the needs to identify customers' problems and solve it through a process in developing new products, in order to meet customer satisfaction. The definition also illustrates that a firm should be the first firm to introduce new products into the market to increase high profitability. Besides, firms that have capabilities to predict market and technological changing are getting an advantage to them to gain sustainable competitive advantage. New product has been classified into six categories which are new-to-the world products, new-to-the-firm products, an addition to the existing product lines, improvements and revisions to existing product, cost reductions, and repositioning (Booz, Allen, & Hamilton, 1982).

New product development process is a complex set of activities that involve every function in business (Wheelwright & Clark, 1992) and also time consuming (Chandra & Neelankavil, 2008). Many organizations use typical process shows in Figure 1. The first stage involves in developing a concept of new product, and the next stage is transforming the idea into a physical product.

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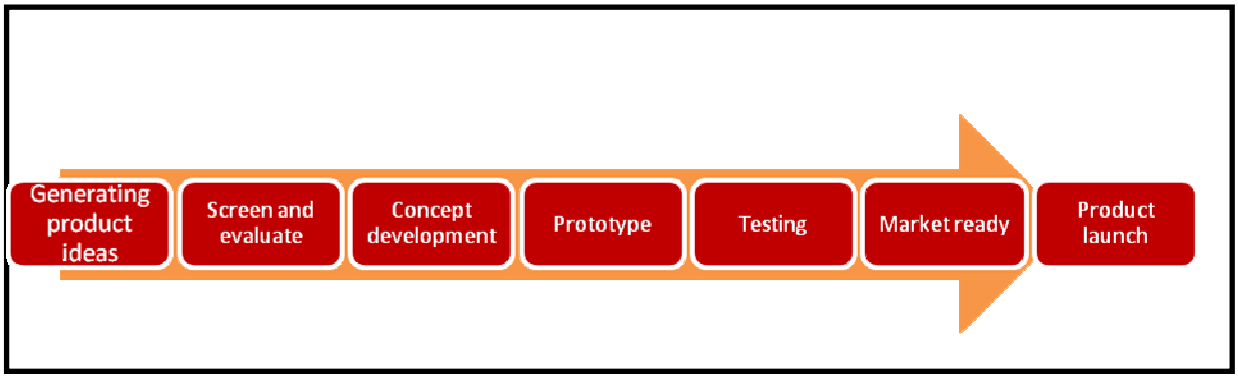

Figure 1: New product development generic process

Generating ideas is the first process in new product development through accumulation related information. The source of ideas is come from every aspect such as internal (e.g. employees), external (e.g. vendors), R&D and competitors. Then, the list of ideas has to be screened and evaluated to select ideas that will be successful and drop those that will not. Next phase is concept development that includes product architecture, conceptual design, target market, desired level of performance, investment requirements, and financial impact. Before the concept of new product can be approved to the next stage, it is fundamental to be tested through small-scale to get feedback from the potential customer and discuss with them to prove out the concept.

The next processes involve phases that transform the proven concept into a tangible product. Prototype is a phase where the activities involve detail engineering, design and develop equipments to be used in commercial production as well as patent analysis and cost forecast. At this phase, designers may develop several similar prototypes, but with different developing method or equipment. After developing the tangible product, it is essential to do a testing, which includes technical testing and market testing. Product that has been successful produced and tested is ready to be marketed, which is involved in commercialization activity, and then launching into the market.

Hence, each department is responsible for certain tasks in the process and will be handed from a department to a department by following the sequential process. Nevertheless, this linear process is not relevant for firms in gaining competitive advantage. Thus, prior studies suggested that new product

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development process should be done concurrently by involving the cross-functional teams (Cooper, 1990; Cooper, Edgett, & Kleinschmidt, 2004).

A process concurrent process that widely employed by firms has been popularized by Robert G. Cooper's research, which is known as a stage-gate system. The process is divided into a number of stages or workstation, and gates. Additionally, between the stages, there is a gate which represents the quality control process to evaluate the outcome before can be proceeded to the next stage after getting approval from the gatekeepers (Cooper, 1990).

A cross-functional team and a leader are commonly needed in this system to move the new product development process from the beginning until the product is launched to the market, and no longer handed the projects from a department to another department. So, project leader essentials to organize the team in ensuring the deliverable inputs in each stage meet the requirement to proceed to the next stage. In each gate, senior managers from each department act as gatekeepers who, includes roles such as reviewing the inputs, assess the quality of the project from an economic and business standpoint, approve the action plan for the next stage and allocate the resources needed by the project. Since the stage-gate system is a parallel processing which activities take place concurrently, cross-functional teams are crucial to ensure the activities can be done in a parallel process, but all activities converge at the next gate.

3. New Product Development Team

The process of new product development is not apart from the people who are working on the process (Craig & Hart, 1992) due to the development activities involve integrating different functions such as marketing, engineering, and manufacturing (Cooper, 1988).

This is shown by a study of 236 managers from R&D, manufacturing, and marketing departments from 16 Fortune 500 firms revealed that integration of cross-functional involvement is differed across the stages of the new product development process (Song, Thieme, & Xie, 1998). At market opportunity analysis stage and in pretesting stage, R&D-marketing integration during these stages is related to product effectiveness. R&D-manufacturing involvement in development stage and in launch stage and manufacturing-marketing involvement in planning and in pretesting also related to the product effectiveness. Meanwhile, four types of joint involvement are related to product efficiency, which is R&D-marketing involvement in development and in pretesting; and R&D manufacturing involvement in planning stage and in launch stage. The variance of integration is due to the nature of tasks and the level

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of interdependence between functions is different. Therefore, through the effective communication formally or informally the information can be transferred to the people who involve in every stage directly. For instance, manufacturing and marketing members should focus on giving the information to the R&D people and participating in product design activities during the development stage as R&D is the main function in this stage.

New product development team is defined as *"a small number of people with complementary skills who are committed to a common purpose, set of professionals goals, and approach for which they hold themselves mutually accountable"* (Reilly, 1999). The scholar explained that a well function team composes six to ten members who possess expertise and experiences that crucially needed to collaborate and sharing their knowledge. Team members also should be committed to the team and responsible to the development of new product which they are concerned on success of product and team members than themselves. In addition, team members able to achieve mutual goals set up by their team and work together to achieve the goals with the empowerment of accountability among team members who enable to increase their self-respect and self-esteem. In developing a team, individual resources such as knowledge, skills, and abilities is played an important role to stimulate teamwork (Day, Peter, & Salas, 2004).

In developing new product development team is not easy as a developing universal team this is because of every project is different according to its degree of technological complexity (Carbonell & Rodriguez, 2006). High degree of the technological complexity project needs people who work for full time and in a high proximity. On the other hand, low degree of the technological complexity project can be done with people who have experienced working as part time doing the tasks, but need to maintain the same people working on the process. Management that considers these criteria of developing new product development teams able to speed up their new product into the market.

New product development team is vital because of its composition consist of people from the different background of expertise. This kind of important composition leads to less time to complete the development of new product. Eventually, the final product probably meets the intended expectations. This positive expectation is happened due to teams provide multidisciplinary knowledge base, for instance, marketing, finance, engineering, design, procurement, fabrication, production, quality, and testing. Besides, team that developed in new product development area, which is well managed gives advantages such as accuracy and completeness, reduces error of omission, reduces risks, reduces surprises, faster market development, and breaks down organizational barriers (Reilly, 1999).

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New product development teams are seen as the vehicle that allows cross-functional collaboration and sharing information to bring the projects to successful completion through high synergy between functions and facing the time pressures to develop the new products faster before competitors and develop the competitive advantage (Carbonell & Rodriguez, 2006). Therefore, firms strive to promote teamwork in their organizations as a core value (Day, et al., 2004).

People in an organization play the important role to ensure the activity to run smoothly and to achieve the set target. Employees who give the high commitment and have high skills serve as valuable, scarce, and no imitable resource that could help firms execute an appropriate strategy (Lado & Wilson, 1994).

A study reported that was about 71 percent of respondents claimed that they used the cross-functional teams in new product development activities in Hong Kong (Ozer, 2006). The scholar also reported that the usage of the cross-functional team is different in US firms and in Hong Kong firms. US firms tend to use cross-functional more often in an innovative project, including new-to-the-world, new-to-the-company, and major revisions. In contrast, Hong Kong firms used cross-functional team in most of the projects and not depending on the product type. This shows that Asian managers expect that they could be able to perform better in a team. Thus, cross-functional teams serve tremendous effects on new product development performance (Cooper, 2007).

Malaysian scholars such as Norsiah (2008) empirically has investigated team characteristics and dynamics such as superordinate identity, cohesion, communication, trust, cooperation and leadership style effect on new product development performance and the moderating effect of top management support in the manufacturing sector. The study attempted to assess the relationship between functional diversity and new product development performance. However, different variables of another team diversity such as knowledge and expertise, skills, and task experience (Jackson, 1996) have not been revealed in the study, which is still lacking in this area. Thus, this study attempted to conceptualize functional diversity and team experience have significant effect on new product development performance.

4. FUNCTIONAL DIVERSITY AND NEW PRODUCT DEVELOPMENT PERFORMANCE

Team functional diversity refers to the team that assembles people from different disciplines and functions, who have pertinent expertise in the proposed course of action (Earley & Mosakowski, 2000). This kind of team has high an absorptive capacity, as their members are diverse in the expert area which let them to share and to gather information and knowledge (Ancona & Caldwell, 1992; Lovelace,

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Shapiro, & Weingart, 2001). Gupta and Wilemon (1990) identified that early involvement of different functional background from early stages of the new product development process, such as R&D, marketing, engineering, and manufacturing are been suggested enable to accelerate new product introduction into the market and beneficial to prevent a lot of money to be spent in unclear product definition during the development process in US technology-based firms. In addition, integration between these functions is really vital in every phase of the new product development process to ensure process efficiency and effectiveness is achievable (Song, et al., 1998).

Nevertheless, putting people from the different expertise background is difficult due to arise on task conflict (Gebert, Boerner, & Kearney, 2006) and disagreement between team members (Lovelace, Shapiro, & Weingart, 2001). Gebert et al. (2006) stated that past empirical findings showed the inconsistent results of the relation between functional diversity and team innovations, whether the positive, negative or non-significant relationship.

Ancona and Caldwell (1992) investigated 45 new product development teams in five high-technology firms, which have found that functional diversity which measures by using entropy-based diversity index is significantly and negatively related to the team innovation performance. Besides, the findings proposed that putting different functions of members is not promising the greater level of innovation. Somehow, external communication is needed to mediate the functional diversity and new product development performance relationship. However, the study limited to the team rating performance and top management rating performance where other objective rating performances should be included, such as speed-to-market, product quality, and development cost.

Contradicting, a study by Zirger and Hartley (1996) has asserted that by increasing number of functional diversity in the new product development team led to accelerate development time performance by examining 44 general managers of electronic firms. However, this study focuses only on a single industry which biased for other various industries to be implemented.

Additionally, Valle and Avella (2003) have indicated that high level of participation of different functional people, for instance, R&D, engineering and design, manufacturing, finances, marketing, suppliers, and customers in the new product development team were significantly impact on new product development performance, particularly reduce development time and development costs as well as increase product quality. The samples represent 125 firms from different industries in Spain and getting

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responses greatly from large firms with 1000 or more workers. Thus, this can reflect the findings to the large firms and slightly bias on the findings.

Another study found that the relationship of functional diversity, which represents the number of departments and external stakeholders and innovation speed has an inverted curvilinear inverted U-shaped function (Carbonell & Rodriguez, 2006). This showed that when functional diversity is increased from low to moderate level, it enhances speed. However, when the functional diversity is going beyond the moderate level, it has a negative effect on innovation speed.

However, Lee and Chen (2007) argued that the relationship between functional diversity and new product development performance was not a curvilinear inverted U-shaped relationship, but direct and positive relationship has been found. The findings determined by using samples of 133 new product development teams at Information Technology (IT) firms in Taiwan.

On the other hand, Norsiah (2008) revealed that the curvilinear relationship between functional diversity and new product development performance is not significant at all by examining 120 new product development teams in Malaysian manufacturing firms. Perhaps, new product development teams in Malaysia's context are more involved in product modification projects rather than truly innovative projects.

Therefore, this can be concluded that functional diversity among team members has mixed results on new product development performance. Regardless, using cross-functional teams is really beneficial when different functional people in a team facilitate high interaction, collaboration and cooperation. Thus, it turns to give positive impact to the new product development performance during the new product development process (Gomes, de Weerd-Nederhof, Pearson, & Cunha, 2003; Kahn, 1996; Olson, Walker Jr., Ruekert, & Bonner, 2001; Tessarolo, 2007). Hence, it is important to have heterogeneous members to ensure the new product can be developed according to planned and simultaneously enable the firms achieve the competitive advantage. Therefore, it is been proposed that:

P1: Functional diversity is significantly related to new product development performance

5. TEAM EXPERIENCE AND NEW PRODUCT DEVELOPMENT PERFORMANCE

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Experience is classified under task attributes' diversity (Jackson, 1996). Team experience is operationalized as team members' knowledge about the past project (Carbonell & Rodriguez, 2006). Team experience is reverse with a construct of information-processing known as memory. Memory is defined as storage of skills and experiences of team members (Akgun, Byrne, Keskin, & Lynn, 2006).

Experiential strategy has been determined as vital in facing uncertainty environment to achieve rapid new product development process (Eisenhardt & Tabrizi, 1995). These experienced-based strategies such as multiple design iterations, extensive testing, frequent project milestones, a powerful project leader, and multifunctional teams significantly contribute to fast development time based on the findings of 72 product development projects from European, Asian, and American computer firms. Iterative experiences trigger the teams to learn faster through learning-by-doing. Therefore, they are capable of reflecting upon changing and do improvisation on the process.

Team experience is an important variable in the new product development team, especially, in selecting team members who are really competent to join the team. By possessing experiences, enable team members to learn from their past involvement in the new product development project which they bring along to be implemented in the new project. If the experience they had before is never been revised and learned will lead to increase of new product failure rates (Sarin & McDermott, 2003). This is proven by a study that emphasized by reviewing past experiences influence on a team's ability to acquire knowledge, then turn to impact new product success (Lynn, Reilly, & Akgun, 2000).

Experience of team members is related to project efficiency and output quality by indicating respondents that involved in software development projects in a firm, Wipro Technologies (Huckman, Staats, & Upton, 2009). The findings obtained is explained that team members who possess more experience able to monitor their own progress, manages their own interdependencies, and deals more effectively with the uncertainty.

Furthermore, McDonald (2005) has determined 135 teams involved in a software project planning exercise revealed that team member's experience in project planning tends to estimate total project cost higher than team member's that had less experience. In addition, lower experience team failed to include some tasks. Then, they estimate shorter time than experience team estimation planning. Estimating lower development cost and shorter schedule compared to actual cost and time by inexperienced teams are having a propensity spending more time and cost developing new product. Thus, it is important to have members who possess experience from the prior similar project which

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enables the team to control their budget plan and adherence schedule planned. Eventually, development cost and speed-to-market able to be reduced.

Madhavan and Grover (1998) argued that the level of new product development team experience gained through their routines and previously working with the same team members lead them to share with others. In-depth interviews with managers and team members from different types of new product development projects represented manufacturing, telecommunications, distribution, chemicals, and electronics industries. The authors also proposed the appropriate level of experience relates to new product development efficiency which, enables to convert embedded knowledge of team members to new product.

On the other hand, Carbonell and Rodriguez (2006) have found that team experience is a significant and positively affect speed-to-market for a technologically simple project rather than technologically complex projects. This study indicated respondents from various industries of 183 new product project that yielded very low response rate which 11.5 percent. Thus, the authors argued that complex technologically projects needs a new experimentation due to the knowledge from prior projects are become obsolete. This situation leads to managers making decision to assign new people to work in the team. However, new comers may not be easily adapted and accepted in the team as Akgun and Lynn (2002) found from an interviewed session with a few managers regarding on this matter and their respond as follows:

"The first question would be if the individual can speed or slow the team down. Also, will the changes increase the workload of the members as they try to train the new members? Another question would be if the new member would contribute at the same level of dedication as them."

As the conclusion, having experience people in new product development teams is essential because of their past knowledge is facilitating to run new product development process even though in lower innovative projects or in high innovative projects. This enables experienced team members to share with the novice members, and their knowledge now becomes explicit knowledge for organizations. Besides, this is necessary after experienced members left the firms, and they bring along their embedded knowledge. Thus, this is a lost for organizations. Experienced team members have to allow themselves to learn new things if their past knowledge is becoming obsolete. So that, the information acquired reduces the uncertainty and triggers high new product development performance. Thus, it is been proposed that:

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P2: Team experience is significantly related to new product development performance

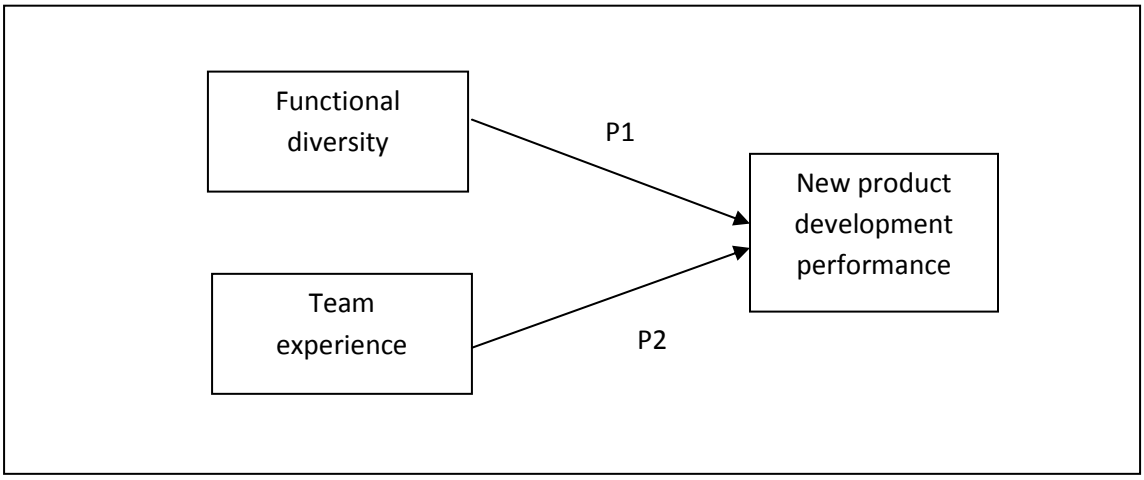

Figure 2: Conceptual framework of the study

Conceptual framework of this study is shown in figure 2 developed based on objective of the study to examine significance of functional diversity and team experience relationships on new product development performance. This study will include variety industries for generalization purpose (Wei & Morgan, 2004), and beneficial for these industries to understand on how do they can get to involve in new product development area without losing their money in terms of development costs and hiring new people. Manufacturing sector embraces the variety of industries involve in product innovation such as food and beverages, machinery, furniture, chemicals, rubber and plastics, fabricated metals, automotive, transport equipment, textile, and electrical and electronic.

6. Conclusion

Having new product development team is vital to ensure the process can be done according to the planned to achieve the set target. Working in team more easily as people can focus and management know who are involved directly in the projects. So that, when the problem arise, the team should be able to take the responsibility and working on searching the solutions. New product development team is complex due to uncertainty in technological and market demand. Besides, they also have to confront the conflicts that potentially arise due to different perspectives of different functional background and experience of team members.

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Functional and experiences diversity have led to the increase of new product development performance. This is because of the tasks in developing new product needs expertise and experience people to handle at each stage. Regardless, the process cannot be finish on time, not meet the expectation quality as well overrun budget. Thus, this is crucial in new product development team to include these people.

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